

## METHOD AND APPARATUS FOR DEPOSITING SNOW-ICE TREATMENT LIQUID ON PAVEMENT

### CROSS-REFERENCE TO RELATED APPLICATIONS

### STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH

Not applicable.

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### BACKGROUND OF THE INVENTION

Roadway snow and ice control typically is carried out by governmental authorities with the use of dump trucks which are seasonally modified by the addition of snow-ice treatment components. These components will include the forwardly-mounted plows and rearwardly-mounted mechanisms for broadcasting materials such as salt or salt-aggregate mixtures. The classic configuration for the latter broadcasting mechanisms included a feed auger extending along the back edge of the dump bed of the truck. This hydraulically driven auger effects a metered movement of material from the bed of the truck onto a rotating spreader disk or "spinner" which functions to broadcast the salt across the pavement being treated. To maneuver the salt-based material into the auger, the dump bed of the truck is progressively elevated as the truck moves along the roadway to be treated. Thus, when into a given run, the dump bed will be elevated, dangerously raising the center of gravity of the truck under inclement driving conditions.

An initial improvement in the controlled deposition of salt materials and the like has been achieved through the utilization of microprocessor driven controls over the hydraulics employed with the seasonally modified dump trucks. See Kime, *et al.*, U.S. Pat. No. Re33,835, entitled "Hydraulic System for Use with Snow-Ice Removal Vehicles", reissued March 3, 1992. This Kime, *et al.* patent describes a microprocessor-driven hydraulic system for such trucks with a provision for digital hydraulic valving control which is responsive to the instantaneous speed of the truck. With the hydraulic system, improved controls over the extent of deposition of snow-ice materials is achieved. This patent is expressly incorporated herein by reference.

Investigations into techniques for controlling snow-ice pavement envelopment have recognized the importance of salt in the form of salt brine in breaking the bond between ice and the underlying pavement. Without a disruption of that bond, little improvement to roadway traction will be achieved. For example, the plow merely will

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concentrated brine over the salt load in a dump bed. This approach is effective to an extent. However, as the brine passes through the granular salt material, it dissolves the granular salt such that the salt will not remain in solution and will recrystallize, causing bridging phenomena and the like inhibiting its movement into a distribution auger.

5           The problem of the technique of deposition of salt in a properly distributed manner upon the roadway surface also has been the subject of investigation. Particularly where bare pavement initially is encountered, snow/ice materials utilized in conventional equipment will remain on the roadway surface at the time of deposition only where the depositing vehicles are traveling at dangerously slow speeds, for example about 15 mph.

10   Above those slow speeds, the material essentially is lost to the roadside. Observation of materials attempted to be deposited at higher speeds shows the granular material bouncing forwardly, upwardly, and being broadcast over the pavement sides such that deposition at higher speeds is ineffective as well as dangerous and potentially damaging to approaching vehicles. That latter damage sometimes is referred to as "collateral

15   damage" or damage to coincident traffic. However, the broadcasting trucks themselves constitute a serious hazard when traveling, for example at 15 mph, particularly on dry pavement, which simultaneously is accommodating vehicles traveling, for example at 65 mph. The danger so posed has been considered to preclude the highly desirable procedure of depositing the salt material on dry pavement just before the onslaught of

20   snow/ice conditions. Of course, operating at such higher speeds with elevated dump truck beds also poses a hazardous situation.

          Kime, *et al.*, in U.S. Pat. No. 5,318,226 entitled "Deposition of Snow-Ice Treatment Material from a Vehicle with Controlled Scatter", issued June 7, 1994, (incorporated herein by reference) describes an effective technique and mechanism for controlling the

25   scatter of the so-called granules at higher speeds. With the method, the salt materials are propelled by an impeller from the treatment vehicle at a velocity commensurate with that of the vehicle itself and in a direction opposite that of the vehicle line of travel. The result is an effective suspension of the projected materials over the surface of pavement under a condition of substantially zero velocity with respect to or relative to the surface

30   of deposition. Depending upon vehicle speeds desired, material deposition may be provided in controlled widths ranging from narrow to wider bands to achieve a control over material placement. See also, U. S. Patent Nos. 5,842,649 and 5,947,391 by Beck et al.

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A practical technique for generating a brine of sufficient concentration to break the ice-pavement bond is described in United States patent No. 5,988,535 entitled "Method and Apparatus for Depositing Snow-Ice Treatment Material on Pavement", by Kime, issued November 23, 1999 and incorporated herein by reference. With this technique, ejectors are employed to deposit a salt-brine mixture upon a roadway as a relatively narrow, continuous and compact band of material. To achieve such narrow band material deposition at practical roadway speeds of 40 mph or more, the salt-brine mixture is propelled from the treatment vehicle at a velocity commensurate with that of the vehicle itself and in a direction opposite that of the vehicle. Further, the material is downwardly directed at an acute angle with respect to the plane defined by the pavement. When the salt-brine narrow band is deposited at the superelevated side of a roadway lane, the resultant concentrated brine from the band is observed to gravitationally migrate toward the opposite or downhill side of the treated lane to provide expanded ice clearance. The result is a highly effective snow-ice treatment procedure with an efficient utilization of salt materials. Because the lanes of modern roadways are superelevated in both a right and a left sense, two spaced apart salt ejectors are employed to deposit the narrow band concentration at positions corresponding with the tire tracks of vehicles located at the higher or elevated portion of a pavement lane. A feature of the apparatus of this system is its capability for being mounted and demounted upon the dump bed of a conventional roadway maintenance truck in a relatively short interval of time. As a consequence, these dump trucks are readily available for carrying out tasks not involving snow-ice control. Additionally, the apparatus is configured such that the dump beds remain in a lowered or down position throughout their use, thus improving the safety aspect of their employment during inclement winter weather.

In addition to the hazards posed by slow speeds of travel, trucks utilized for snow-ice treatment exhibit difficulties negotiating ice coated roadways, particularly where uphill grades are encountered. One technique for driving upon such ice coated hills has been to turn the trucks around, activate the rear mounted salt broadcasting spinner and travel up the incline in reverse gear. This procedure achieves only marginal traction and is manifestly an undesirable solution to this traction problem.

An improvement in zero relative velocity broadcasting technique is described in U. S. Patent No. 6,446,879, entitled "Method and Apparatus for Depositing Snow-Ice Treatment Material on Pavement" by Kime, issued September 10, 2002, in which narrow band ejection of salt and brine is provided in a manner wherein it is encountered by the

5 rear drive wheels of a dump truck. For both approaches of the above-described narrow band deposition, the dump truck structuring is such that use may be made of them for purposes other than snow-ice control during winter seasons. In this regard, roadway maintenance organizations require that the dump trucks be capable of being used for such purposes as hauling gravel and/or pothole repair materials.

10 Over the recent past, investigators have returned to the subject of pre-treating a bare or dry roadway pavement before a weather event occurs otherwise generating ice/pavement bond conditions. Rather than attempting to deposit granular salt on a roadway, brine is placed on the roadway in small, angularly downwardly directed streams spaced about eight to twelve inches apart and usually extending across a width of one driving lane. The total application rate usually is thirty to sixty gallons of salt brine per lane mile. Where clear weather permits, the resultant brine strips will dry leaving a tenaciously bonded strip of fine salt along the pavement somewhat emulating paint. With continued dry weather, these fine crystalline strips will remain on the pavement for 15 several days or more except for some deterioration along tire track regions. When snow conditions then commence, the resultant moisture will activate the strips to attack the very development of an ice/pavement bond condition. Rubber edged squeegee plows have been used to remove a resulting un-bonded slush from the pretreated roadway. Some governmental roadway organizations consider a multi-nozzle broad deposition of 20 brine also to be beneficial in the de-icing treatment of roadways which are frosted or carrying low water content "black ice".

The excellent effectiveness and attendant environmental and economic advantages of brine treatment programs is significant. In general, governmental roadway organizations consider that an initial application upon roadways under snow/ice 25 conditions for example, on interstate roadways will be about six hundred pounds of granular salt per mile. A pretreatment of liquid brine, for example, at about sixty gallons per mile will invoke the use of a corresponding amount of salt from between about 100 and 125 pounds. Of particular interest, because the brine can be deposited well before an impending weather event, trucks and drivers can be utilized during normal working 30 hours. In compliment with these economies, improvements have been made in the techniques employed for forming the brine solutions prior to loading on the depositing trucks. See, for example, application for United States Patent Serial No. 09/961,469, by Kime, entitled "Brining System, Method and Apparatus" filed, September 24, 2001.

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